Monterey Pine Ips

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The Monterey pine ips *(Ips radiatae* Hopk.) is a major insect pest of Monterey pine (*Pinus radiata* D. Don), and it attacks several other pine species within its range. Periodically this engraver beetle becomes sufficiently abundant to damage and kill scattered trees over many square miles of native Monterey pine forests, from the San Francisco Bay area and Monterey Peninsula southward to Cambria in San Luis Obispo County, Calif.

Its infestations are often mixed with those of a related species, the California four-spined ips (*Ips plastographus* (Lec.)), also a major insect pest. Less frequently its infestations are mixed with those of the California five-spined ips (*I. confusus* (Lec.)). All three insect species breed abundantly in fresh Monterey pine slash resulting from logging, wind breakage, or land clearing; this debris is a common source of outbreak infestations in stands of Monterey pine.

The Monterey pine ips also infests lodgepole pine (*Pinus contorta* Dougl.), knobcone pine (*P. attenuata* Lemm.), whitebark pine (*P. albicaulis* Engelm.), Jeffrey pine (*P. jeffreyi* Grev. & Balf.), limber pine (*P. flexilis* James), and bishop pine (*P. muricata* D. Don). Its range includes British Columbia and Alberta, Canada; Washington, Idaho, Montana, Wyoming, Utah, Oregon, and California (fig. 1). California locations where the in-

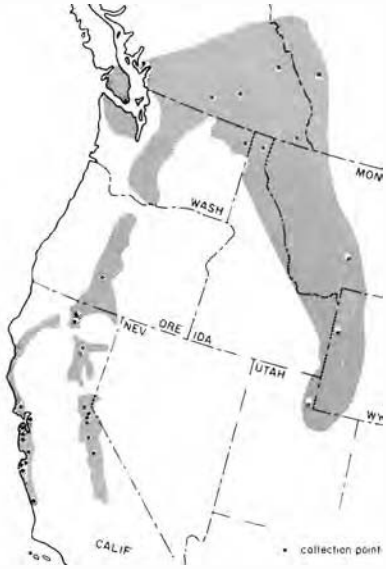

Figure 1.—Distribution of the Monterey pine ips.

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sect has been found in tree species other than Monterey pine include Sequoia National Park, Tulare County; Lake Tenaya, Mariposa County; Lake Tahoe, Echo Lake, Wrights Lake, and Pyramid Ranger Station, El Dorado County; Lassen National Forest, Lassen County; Medicine Lake and Lake Eiler, Shasta County; and Inverness, Marin County. Elevations within the range of distribution vary from sea level to over 9,000 feet.

Attacks on Monterey pine by this beetle kill branches, tops, and sometimes entire trees. Attacking beetles often hit scattered individual trees or groups of trees in both natural and planted Monterey pine stands. Infestations in park or estate plantations often ruin trees highly prized for their esthetic value in scenic areas.

The frequent occurrence of this insect in trees other than Monterey pine is revealed by collection records and authentic identifications. This beetle may do similar damage to these hosts, but just how injurious it is to them is not known. Its habits are believed to be similar in all hosts, although its life cycle may differ. The great variation in climatic requirements of the different host trees suggests that there may be subspecies or varieties of this beetle, but this has not been demonstrated.

Evidence of Infestation

Attacks in Monterey pine usually go undetected until a limb, a top, or much of the tree crown has begun to fade. Where slash has resulted from summer logging or clearing operations, reddened foliage of limbs or tops may show up in nearby infested trees in the fall. Most often, dying trees show up during the late fall, winter, and spring months (fig. 2). They indicate fall attacks by the Monterey pine ips, the California four-spined ips, or both. The reddened crowns of young suppressed trees also indicate attacks by these insects. Woodpeckers working along the main stem of a tree, or the holes they make in the bark, may provide clues to an infestation before a tree has begun to fade.

Description

Eggs of the Monterey pine ips are about ¾ mm. long, off-white, glossy, and characteristically ovoid (fig. 3, *A*). They are deposited in niches (pockets) and packed in tightly with a plug of borings. Usually four eggs, but as few as two are deposited in each pocket.

The larva (fig. 3, *B*) is an off-white, deeply wrinkled, legless grub. The head is light tan to reddish brown. Body color variations result from ingested phloem materials.

The pupa (fig. 3, *C*) develops in a cell formed by the fully grown larva. This stage is quiescent, off-white, and glossy. The embryonic head, appendages, and body are in the general form of the adult. Gradual darkening of tissues occurs in development with approach toward adulthood.

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Figure 2.—Damage to Monterey pine by ips beetles: *A*, Group-killing in young plantation of pole-sized trees; *B*, fading tree crown (center) and scattered fading limbs in tree crown (right) in stand of mature trees.

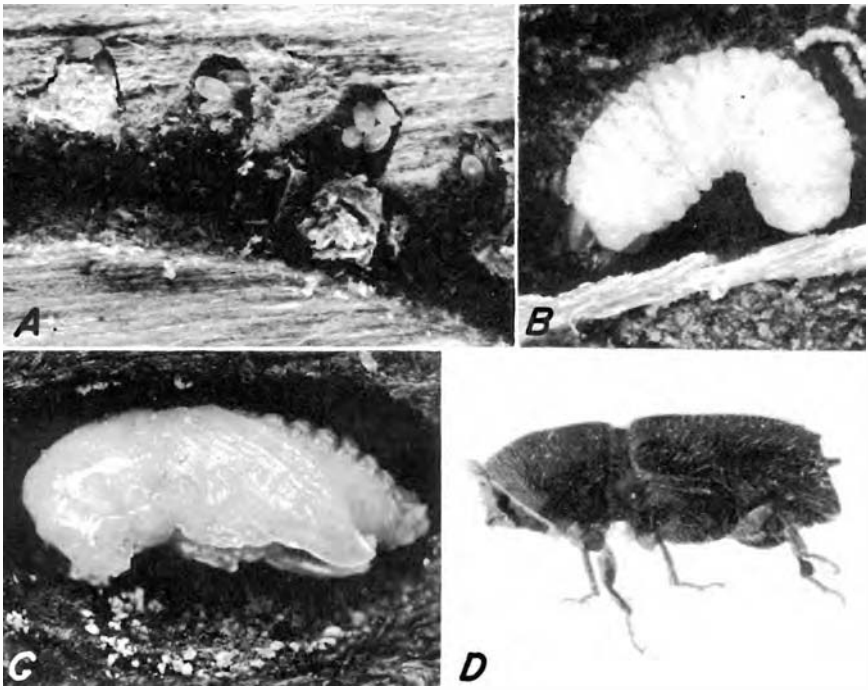

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Figure 3.—Life stages of Monterey pine ips: *A*, Egg pockets containing eggs (×5); *B*, larva (×10); *C*, pupa in cell (×10); *D*, adult (×10).

The adult (fig. 3, *D*) is light tan just after transformation from the pupa, turning gradually darker to reddish brown, then jet black. The body is thinly clothed with fine short hairs. Three toothlike projections occur along the outer declining margins of each wing cover; the middle projections stand out prominently. The average adult length is 5 mm.

Life History

Development from egg to adult is most rapid during summer and fall. Eggs hatch in 4 to 8 days. Larvae complete their development in 6 to 7 weeks. At the end of the fourth week, small hairs appear on the side of the head and on the last three abdominal segments of each larva. Pupal cells are constructed at the end of the sixth week and during the seventh. Within these cells pupation takes place during the eighth week. Adults appear during the ninth week; very few mature before the onset of winter. Overwintering stages are primarily adults and larvae, although eggs, small and large larvae, and pupae have been observed. In other seasons all stages may be found; there is considerable brood overlap.

Available records indicate up

to three generations are produced each year under optimum conditions. Varying temperatures within Monterey pine stands account for differences that may occur in the number of generations or the overlapping of generations.

In lodgepole pine a single life record at Lake Tenaya, Calif., between September 9, 1917, and September 15, 1918, provided evidence of a single generation per year.

Habits

Fresh slash is attacked readily. Abundant broods are produced in the slash within the inner bark of stems varying from 3 to more than 20 inches in diameter, and having bark from ¼ to 1 inch thick.

Stands of maturing trees may be attacked when weakened by competition, drought, mistletoe infection, basal stem infestations of the red terpentine beetle (*Dendroctonus valens* Lec.), or fungus infection by *Peridermium* species. Outbreaks are most likely to occur when weakened trees are close to abundant broods in slash.

Attacks of the Monterey pine ips are started by the male. It bores through the bark and excavates a rounded, central nuptial chamber, two to three times the diameter of the egg tunnels (fig. 4, *A*). On completion of the chamber, the male is followed by two females and sometimes three. The male remains in the nuptial chamber to mate periodically with the females and help remove excessive borings and frass material from egg tunnels, which are extended by the females.

Typically, two unobstructed tunnels extend outward from the chamber in opposite directions, for a fraction of an inch to more than an inch away, then curve in varying amounts, usually up to 90 degrees, and finally either straighten out or wind for several inches. Often the curving continues into a circular or S-shaped pattern. Deep niches, spaced evenly along the outer side of tunnel curves and the same side of the straight tunnel section, are where the eggs are laid. Each female lays about 90 eggs. However, it is recorded that more than 170 eggs have been deposited by one female.

From each niche, two to four tiny, frass-filled larval tunnels fan narrowly outward, enlarging with distance from the egg tunnel (fig. 4, *B*). Larval tunnels may extend 5 or more inches from the egg tunnel, each enlarging to a maximum width approaching that of the egg tunnel, and ending in an oval-shaped cell or pupation chamber.

Natural Control

Several species of insects and a predaceous mite have been found attacking both adult and immature stages of the Monterey pine ips. The more common insect predators are beetles that attack both as adults and as larvae. These are the green trogositid (*Temnochila virescens chlorodia* (Mann.)), the black-bellied clerid

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Figure 4.—Tunneling pattern of adults and larvae of Monterey pine ips: *A*, Egg tunnel leading from nuptial chamber showing larval tunnels fanning out from common centers along outer side of egg tunnel curve (natural size); *B*, new larval tunnels radiating from egg pocket along outer side of egg tunnel curve.

(*Enoclerus lecontei* (Wolc.)), the red-bellied clerid (*E. sphegeus* (Fabr.)), and a flattened red beetle (*Cucujus clavipes* (Fabr.)). Attacks by braconid (Hymenoptera) parasites identified as species in the genus *Coeloides* are believed to be important. A small grayish mite marked by a light dorsal band (family Tyroglyphidae) is an important predator of the eggs and larvae.

Fungi of various kinds occur in the egg galleries and larval tunnels, and some are believed to cause brood mortality. Deaths of larvae, pupae, and adults of the Monterey pine ips have been ascribed to the herbarium mold (*Eurotium herbariorum* (Wigg.) Link) and blue-green molds belonging to the genus *Penicillium*. Blue-stain fungi (*Ceratostomella* spp.) are introduced by attacking beetles. They cause deep staining of the sapwood and cambium region but are not believed to cause brood mortality.

Applied Control

Population of this beetle can be kept at a low level by preventing the accumulation of fresh Monterey pine slash with stems larger than 3 inches in diameter. Slash resulting from winter storm breakage should be removed from the woods or sprayed with insecticide before the end of spring. From mid-February to mid-November, slash from thinning, clearing, or logging should not be left in the woods for longer than 4 weeks if it is not sprayed. Each felled tree should be utilized to as small a top diameter as is practicable.

Preventing stagnated or highly competitive growth conditions in Monterey pine forests will help combat the beetle. Stands should be kept vigorous through silvicultural practices designed to permit optimum spacing for light and moisture. Insect-infested trees and those infected with fungi or mistletoe should be held to a minimum. Tree roots should not be disturbed by fills or excavations.

Because strong winds create much slash, an appraisal of damage soon after severe winter storms in advisable to determine the amount and distribution of potential breeding material. Uninfested slash accumulations can be protected from beetle attacks by thoroughly wetting the bark surface with a lindane spray. This is prepared by mixing 1 gallon of 20-percent emusifiable concentrate in 14 gallons of No. 2 fuel oil and is applied with a low-pressure sprayer.

Heavy infestations in slash can be suppressed by using either a lindane or ethylene dibromide (EDB) spray. Prepare the lindane spray as described in the previous paragraph and apply just enough to wet the bark thoroughly. Prepare the EDB spray by mixing 1 pint of 85-percent emulsifiable concentrate in enough No. 2 fuel oil to make 5 gallons. Apply it with a low-pressure sprayer to the point of runoff.

Outbreak populations in living stands can be suppressed by felling the infested trees and destroying broods by rapid utilization of the wood and by spraying slash as just described. Infestations in logs transported to nearby mills and immediately processed will be destroyed in the milling. Broods in the remaining slash and in logs not to be used at once can be destroyed by spraying the host material or by running it through a chipper to convert it to fine particles.

Caution:

Pesticides used improperly can be injurious to man, animals, and plants. Follow the directions and heed all precautions on the labels.

Store pesticides in original containers under lock and key—out of reach of children and animals—and away from food and feed.

Apply pesticides so that they do not endanger humans, livestock, crops, beneficial insects, fish, and wildlife. Do not apply pesticides when there is danger of drift, when honey bees or other pollinating insects are visiting plants, or when they may contam-

inate water or leave illegal residues.

Avoid prolonged inhalation of pesticide sprays or dusts; wear protective clothing and equipment if specified on the container.

If your hands become contaminated with a pesticide, do not eat or drink until you have washed. In case a pesticide is swallowed or gets in the eyes, follow the first aid treatment given on the label, and get prompt medical attention. If a pesticide is spilled on your skin or clothing, remove clothing immediately and wash skin thoroughly.

Do not clean spray equipment or dump excess spray material near ponds, streams, or wells. Because it is difficult to remove all traces of herbicides from equipment, do not use the same equipment for insecticides or fungicides that you use for herbicides.

Dispose of empty pesticide containers promptly. Have them buried at a sanitary land-fill dump, or crush and bury them in a level, isolated place.

WARNING: Recommendations for use of pesticides are reviewed regularly. The registrations on all suggested uses of pesticides in this publication were in effect at press time. Check with your county agricultural agent, State agricultural experiment station, or local forester to determine if these recommendations are still current.

Reference

LIFE HISTORY AND HABITS OF TWO PACIFIC COAST BARK BEETLES. F. M. TRIMBLE. Ent. Soc. Amer. Ann. XVII (4): 382–390. Dec. 1924.

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